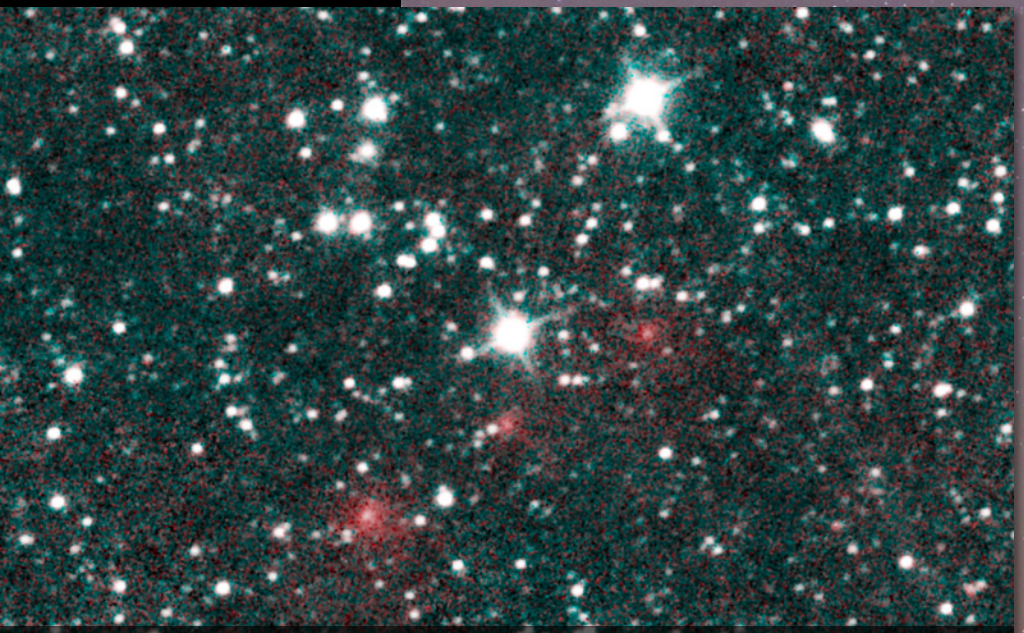
Planetary Defense Coordination Office

Lindley Johnson
NASA's Planetary Defense Officer

Planetary Defense Coordination Office
Planetary Science Division
NASA Headquarters
Washington, DC

Update to PAC
30 November 2020

Comet C/2020 F3 NEOWISE



Discovery image sequence by the NEOWISE mission, March 27, 2020 (red dots)

Comet C/2020 F3 NEOWISE over NASA's Infrared Telescope Facility (*M. Connelley/IRTF/UH)*

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2020 SO – Likely Centaur upper stage from 1966 Surveyor 2 launch, temporarily captured from heliocentric orbit.

Spectroscopy will conclusively confirm artificial nature.

New Close Approach Record Set in August 2020 and Broken Three Months Later

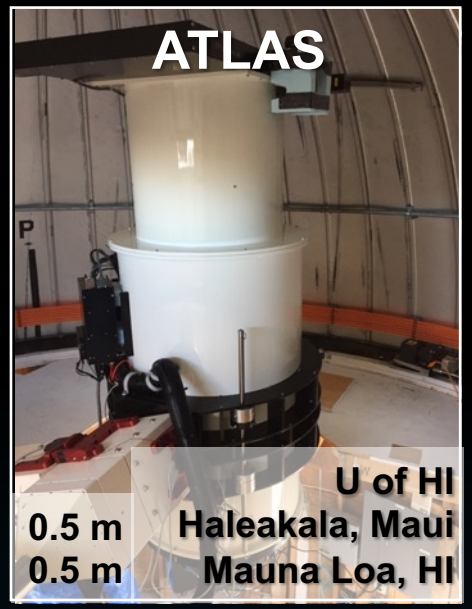
Closest ***known*** approach to Earth by an asteroid, without entering the atmosphere:

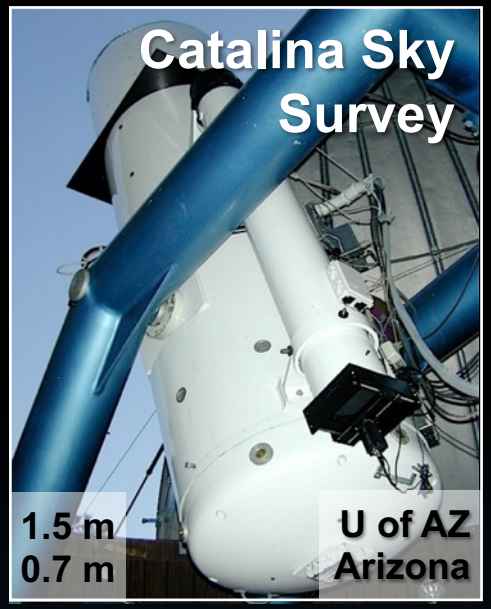
~~August 16, 2020~~
~~2020 QG~~
~~3-6 meters in size (estimated from visual magnitude)~~
~~2,950 kilometers above Earth's surface~~
~~First reported by Zwicky Transient Facility (Caltech)~~

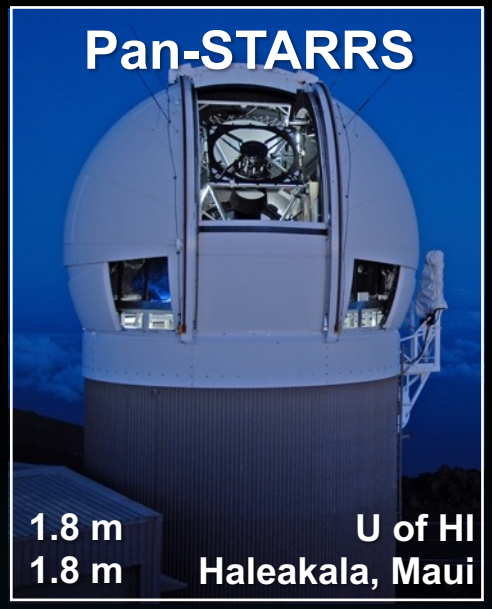
November 13, 2020
2020 VT4
5-11 meters in size (estimated from visual magnitude)
375 kilometers above Earth's surface
First reported by ATLAS (U. of Hawai'i)

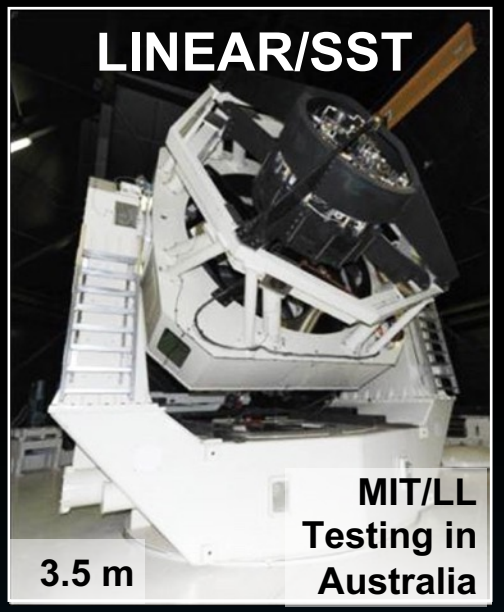
NASA's NEO Search Program

(Current Survey Systems)









Sites in Chile and South Africa to be commissioned in 2021

Also processing of data for NEO detections from Caltech's Zwicky Transient Facility

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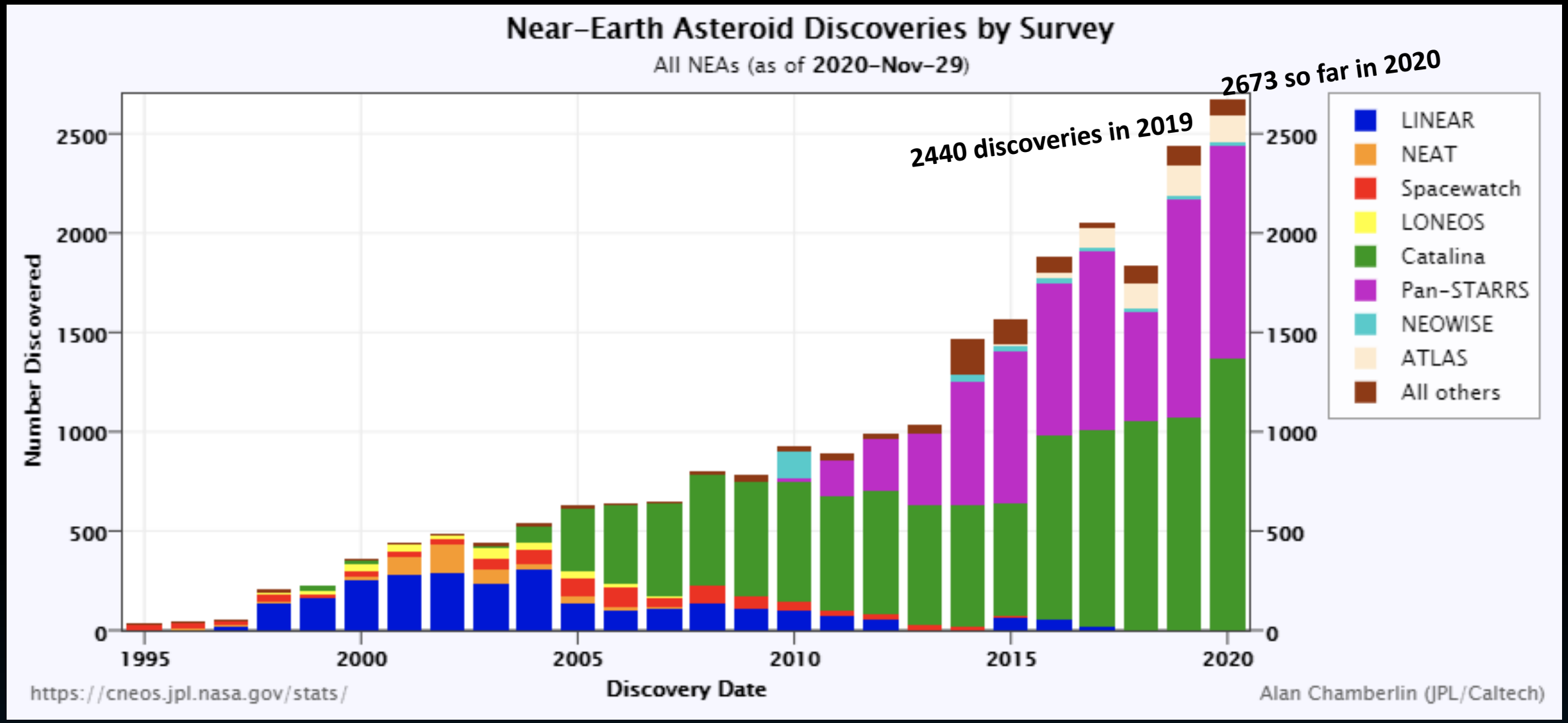
All Near-Earth Asteroids (NEAs)

NASA



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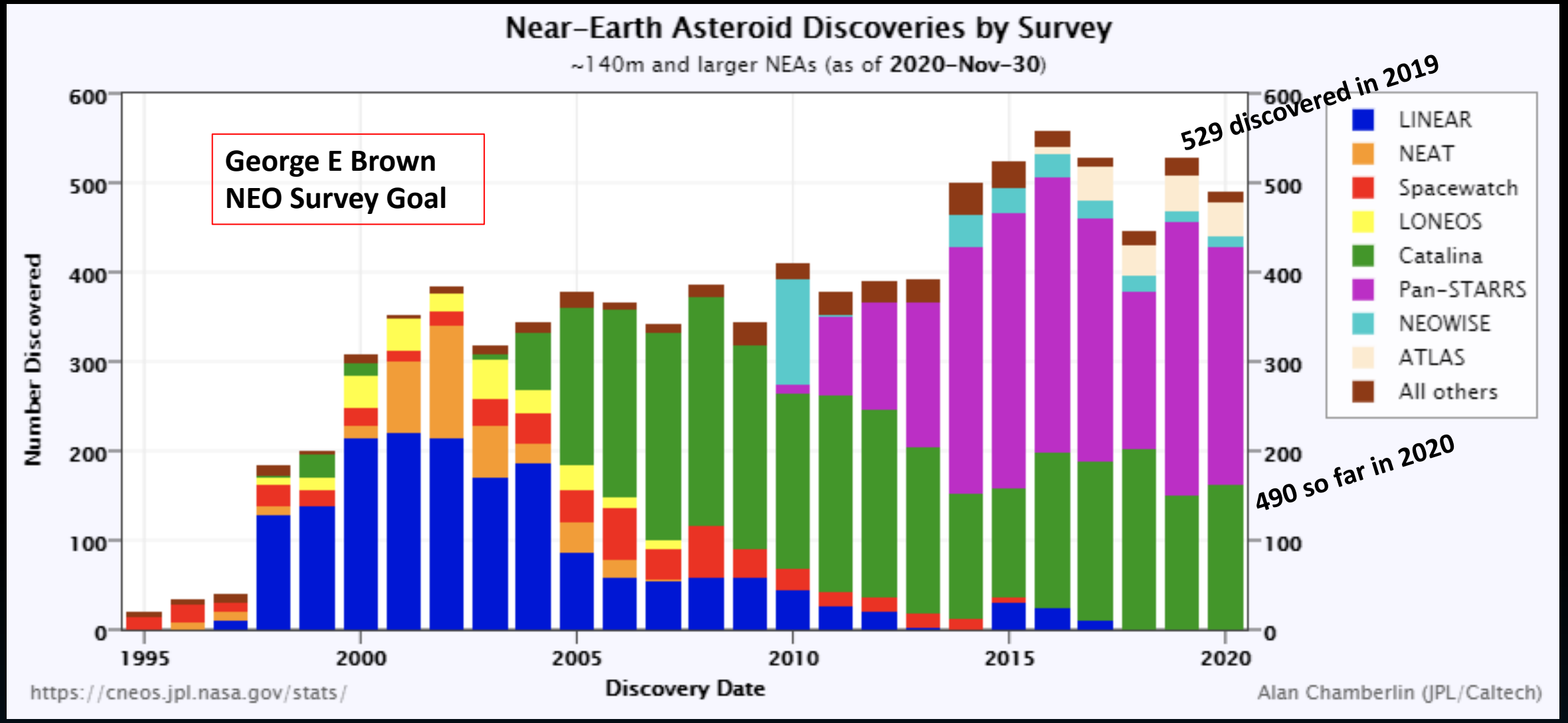
NEAs 140 Meters and Larger

NASA



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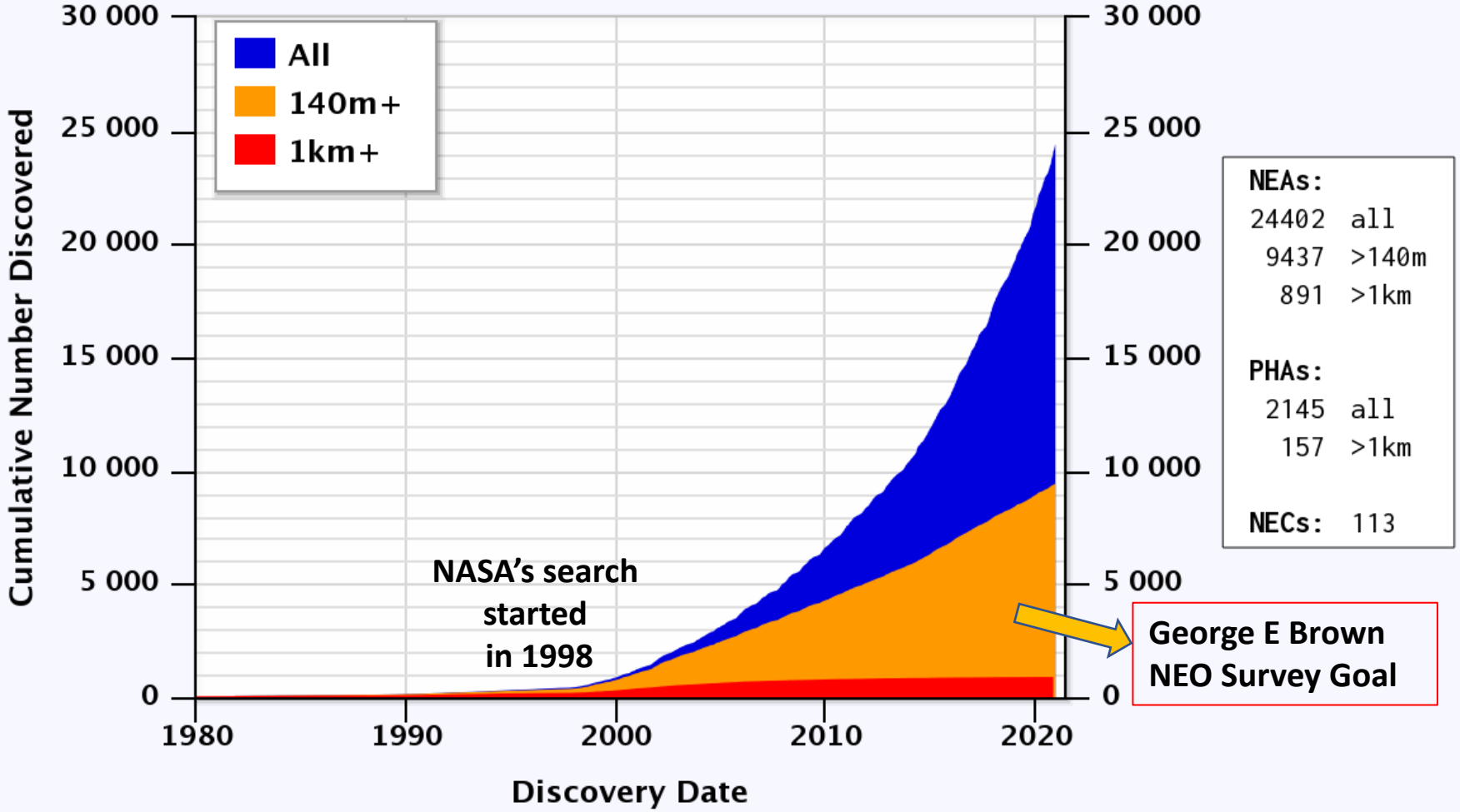
Near-Earth Asteroids Discovered

Most recent discovery: *2020-Nov-27*



https://cneos.jpl.nasa.gov/stats/

Alan Chamberlin (JPL/Caltech)

**Potentially Hazardous Asteroids come within 7.5 million km of Earth orbit*

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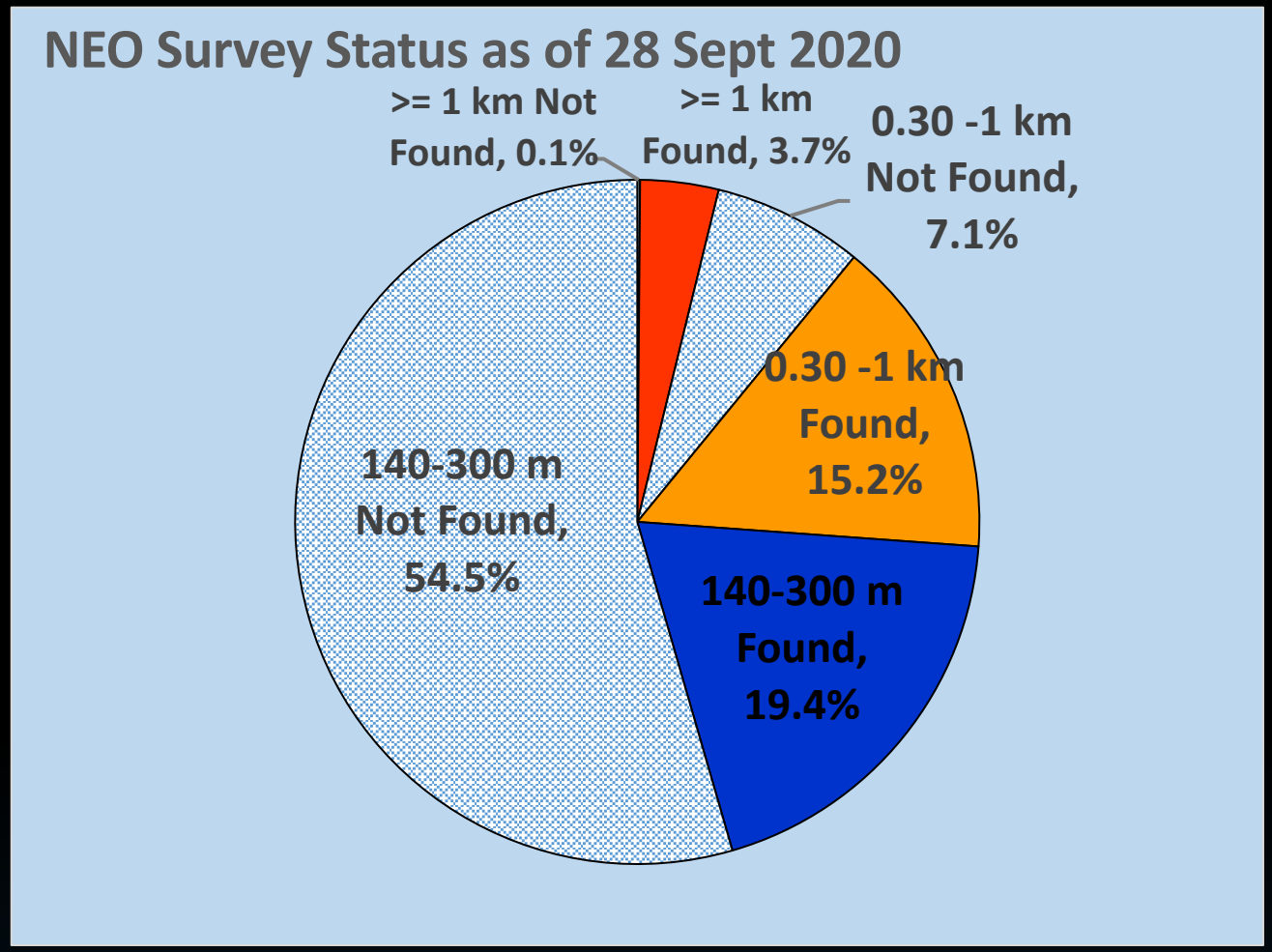
Progress: 140 Meters and Larger

Total Population estimated to be ~25,000

George E Brown NEO Survey Goal

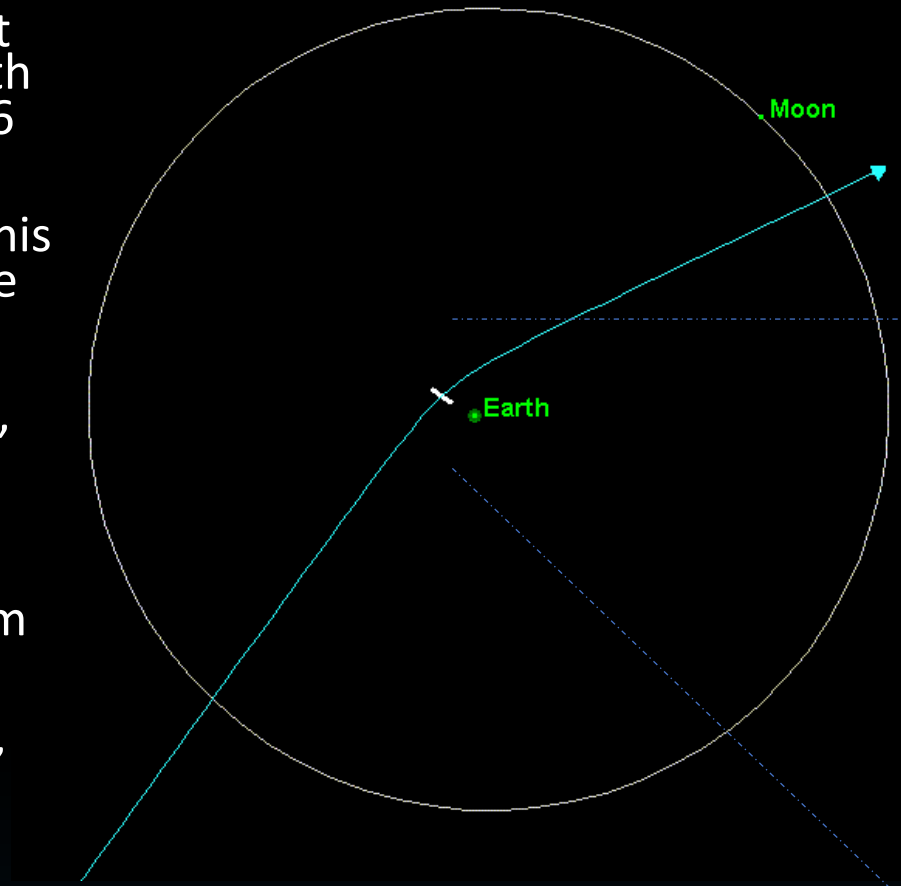


At current discovery rate, it will take more than 30 years to complete the survey.

Apophis Close Approach

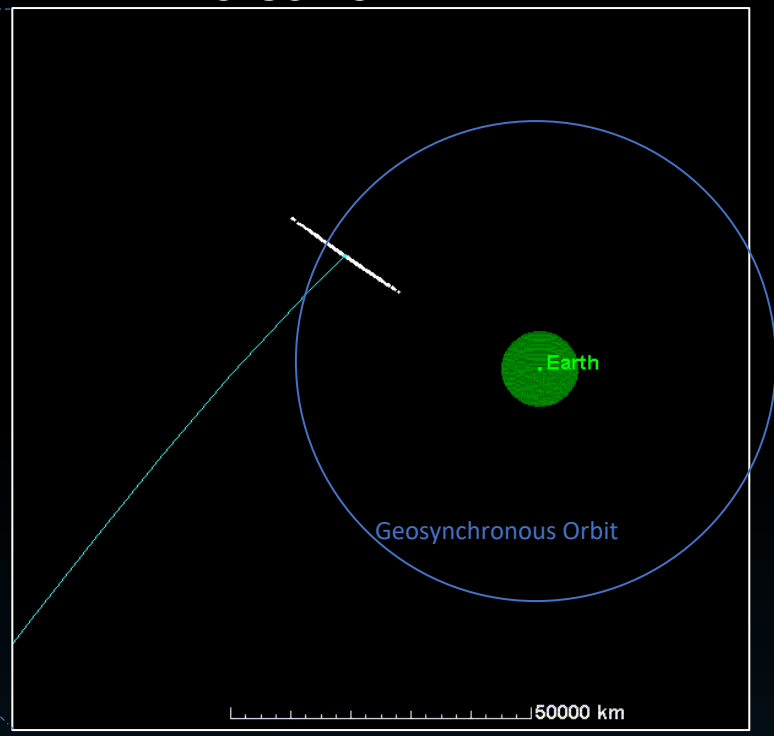
- Apophis will reach its point of closest approach to Earth on April 13th, 2029, at 2146 UTC.
- At closest approach, Apophis will pass ~31,000 km above Earth's surface (~4,500 km closer to Earth than geo-synchronous orbit altitude, but well above the orbit plane)
- It will be visible to the human eye. Best view from "The Med"
- About 16 hrs 45 mins later, Apophis will pass within about 96,000 km of the Moon

https://twitter.com/JimBridenstine/status/1257669052085960705\



Predicted Close Approach of
2004 MN4 "Apophis"
(an ~340m Object)
on April 13, 2029

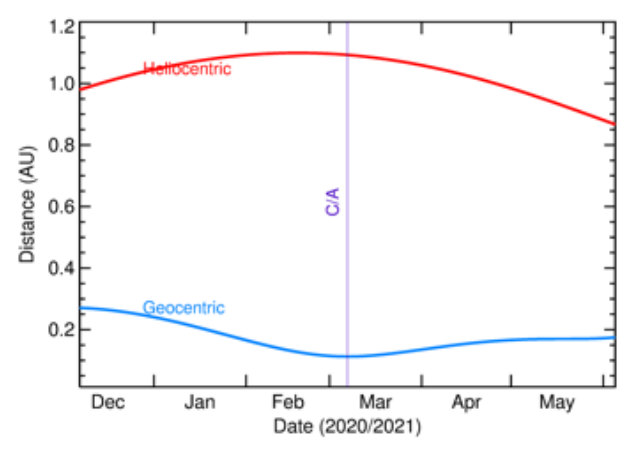
CLOSE-UP VIEW

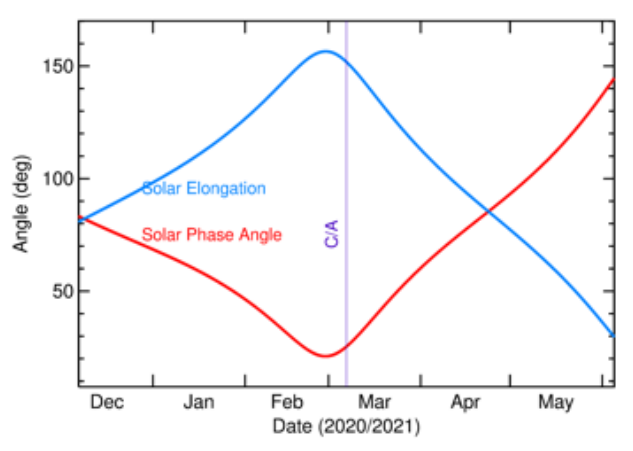


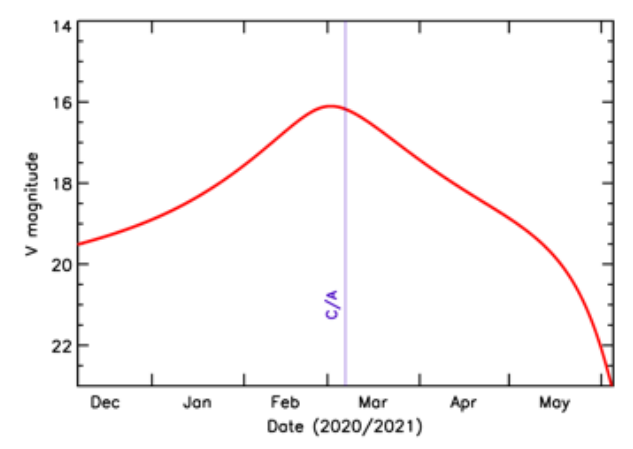
Other **known** PHOs of significant size will pass within lunar orbit this decade, eg 2001 WN5

International Asteroid Warning Network (IAWN)
Apophis 2021: Planetary Defense Campaign

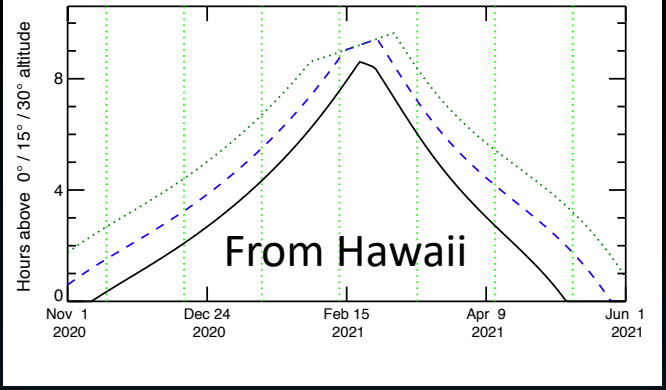
- Best observing opportunity until 2029. Closest on March 6, 2021 (CA dist ~0.11 AU).
- Makes for an iconic target for global planetary defense exercise
- Campaign Page: http://iawn.net/obscamp/Apophis/ Campaign Coordinator: Vishnu Reddy

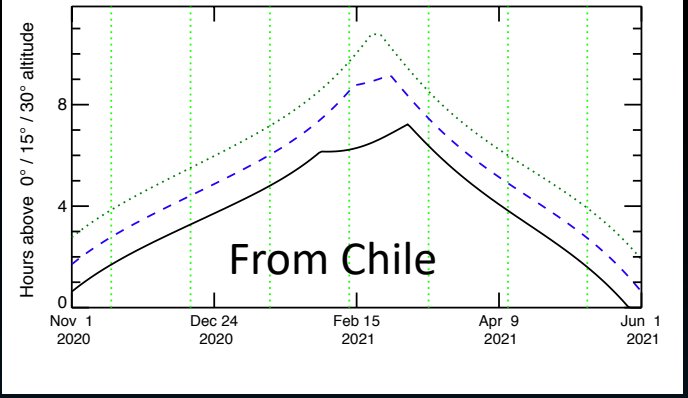


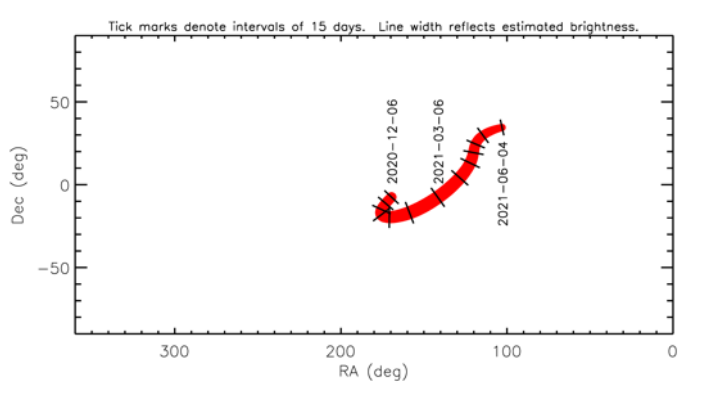




Accessible to mid-latitude observatories







Plots courtesy of T. Farnham

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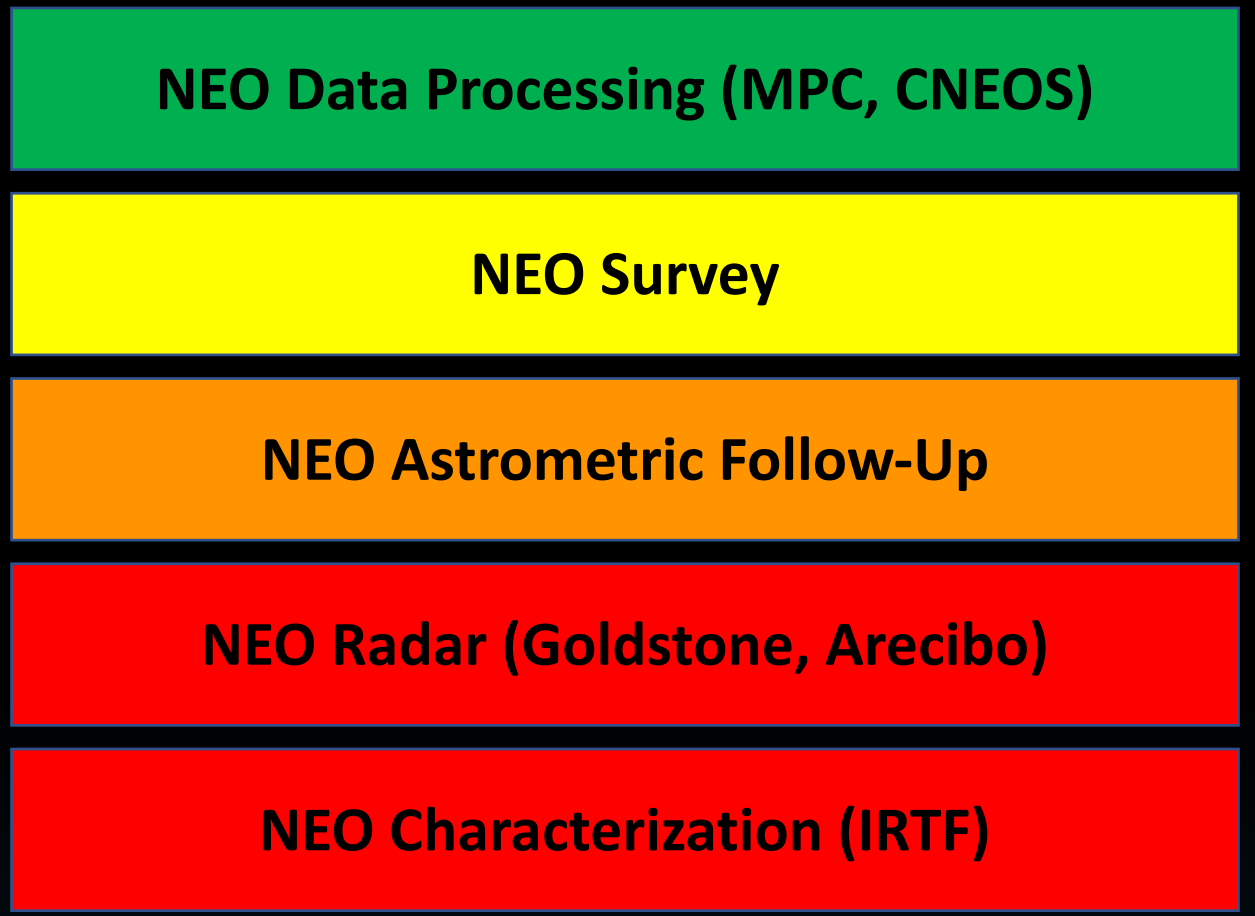
NEO Observations Program Status
March 19, 2020 – Peak of COVID-19 Impacts



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NEO Observations Program Status
November 17, 2020

NEO Data Processing (MPC, CNEOS)

NEO Survey

NEO Astrometric Follow-Up

NEO Radar (Goldstone, Arecibo)

NEO Characterization (IRTF)

NASA Planetary Radar Update

Goldstone Planetary Radar
Returned to full-power (450 kW) operations as of Nov. 2020

Arecibo Planetary Radar
Controlled decommissioning of 305m telescope announced by NSF on 19 Nov. 2020 following two cable failures

Arecibo – Planned controlled decommissioning of 305m telescope announced by NSF on 19 Nov. 2020

NSF Release:
https://www.nsf.gov/news/news_summ.jsp?cntn_id=301674
NASA Release:
https://www.nasa.gov/feature/nasa-statement-on-nsf-s-planned-controlled-decommissioning-of-arecibo-radio-telescope

Impact to NASA NEO observations and planetary science of Arecibo's 305-meter radio telescope planned decommissioning

- NASA has funded planetary radar equipment, operations, and science on Arecibo's 305-meter radio telescope
- The planned decommissioning of Arecibo's 305-meter radio telescope fortunately will have only a slightly negative impact to NASA's NEO observation mission
- NASA's NEO search efforts will not be affected given that radars such as the one at Arecibo are used only to characterize known NEOs that come within radar range, not to discover previously unknown asteroids and comets. The objects must first be discovered and tracked by optical telescopes to provide the pointing and distance information needed so detection by these types of radars can be possible.
- NASA's 70-meter Goldstone Solar System Radar has greater pointing capability but less range than Arecibo's planetary radar. Some scientific research on planets and distant asteroids will be impacted due to the need for the range offered by the capabilities of Arecibo Observatory.
- NASA will continue to utilize the 70-meter Goldstone Solar System Radar facility in California to characterize known NEOs. The Goldstone facility recently returned to full operations after successful delivery and testing of a new klystron tube for its high-power transmitter.

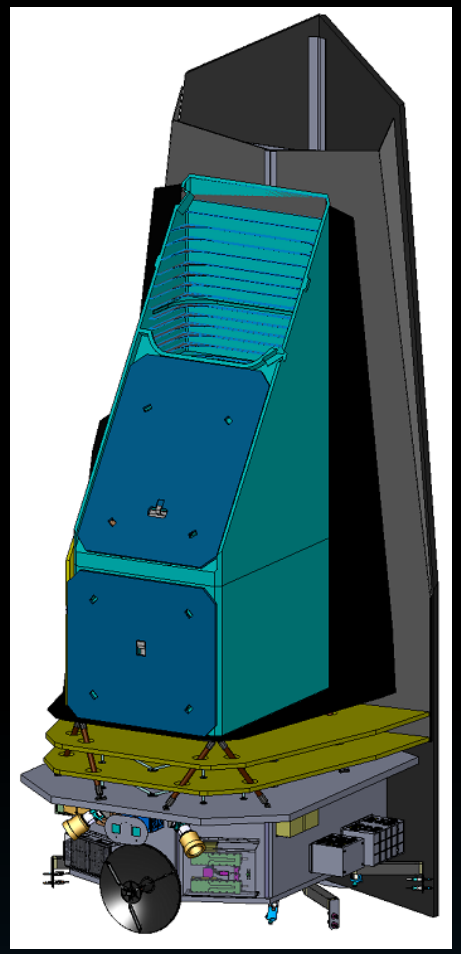
NASA Release:
https://www.nasa.gov/feature/nasa-statement-on-nsf-s-planned-controlled-decommissioning-of-arecibo-radio-telescope

NEO Surveyor

Objectives:

- Find 65% of undiscovered Potentially Hazardous Asteroids (PHAs) >140 m in 5 years (goal: 90% in 10 years)
- Estimate sizes directly from IR signatures
- Compute cumulative chance of impact over next century for PHAs >50 m and comets
- Deliver new tracklet data daily to the Minor Planet Center
- **KDP-B scheduled before end of calendar year**
  - **DPMC to be held 8 December**

NEO Surveyor
Space-based IR
Observatory



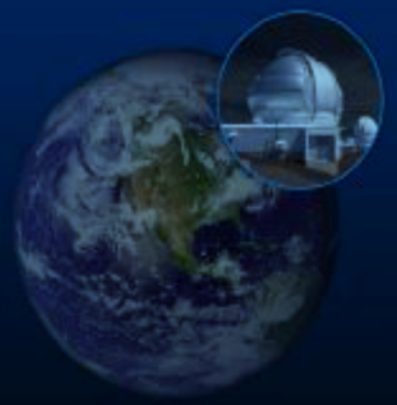
Launch

July 22, 2021

DART

Double Asteroid Redirection Test

IMPACT: September 30, 2022



LICIACube
(Light Italian Cubesat for Imaging of Asteroids)
ASI contribution

DART Spacecraft

650 kg arrival mass
18.8 m × 2.4 m × 2.0 m
6.65 km/s closing speed

Didymos-B

163 meters
11.92-hour orbital period

65803 Didymos (1996 GT)

1,180-meter separation between centers of A and B

Didymos-A

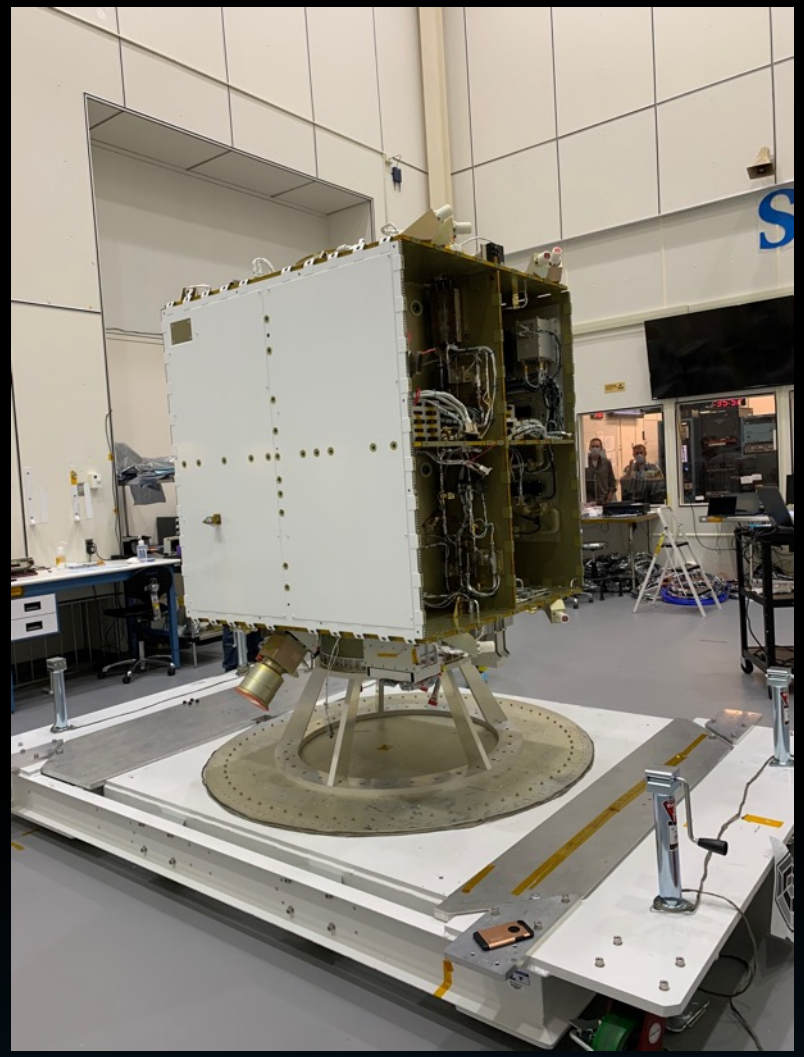
780 meters, S-type
2.26-hour rotation period

Earth-Based Observations

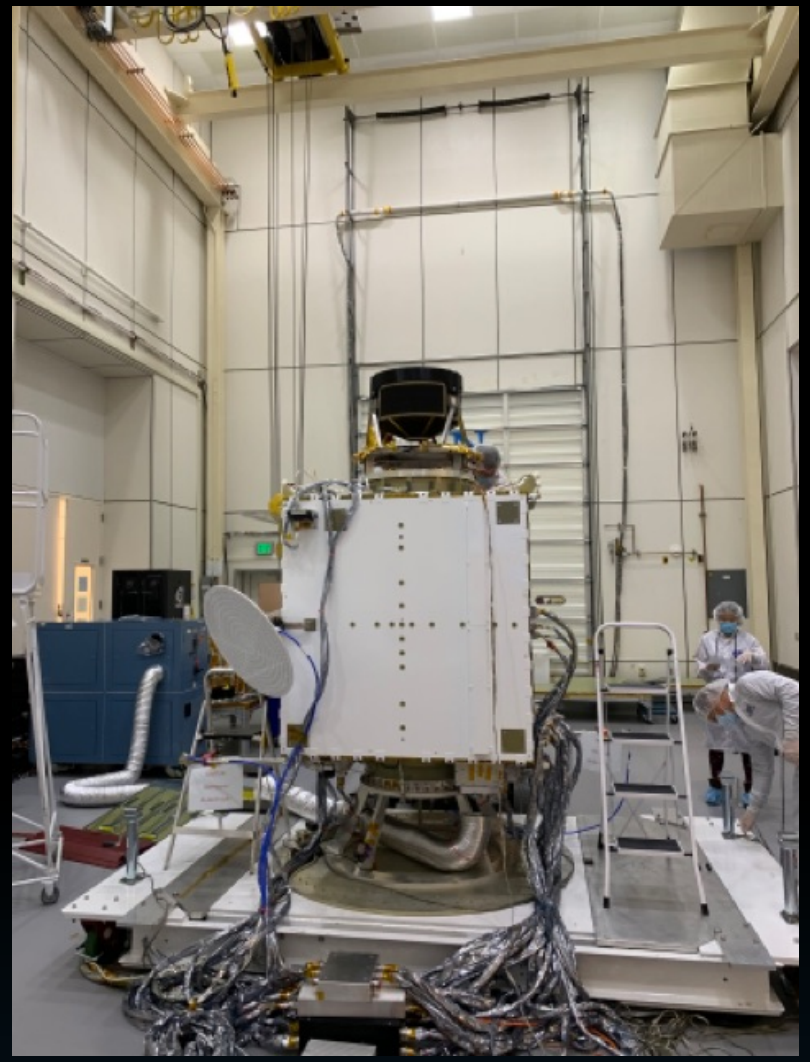
0.07 AU range at impact
Predicted ~10-minute change in binary orbit period

- Target the binary asteroid Didymos system
- Impact Didymos-B and change its orbital period
- Measure the period change from Earth

DART I&T Going Well



Spacecraft side panels installed late Sep 2020



NEXT-C Thruster installed early Nov 2020

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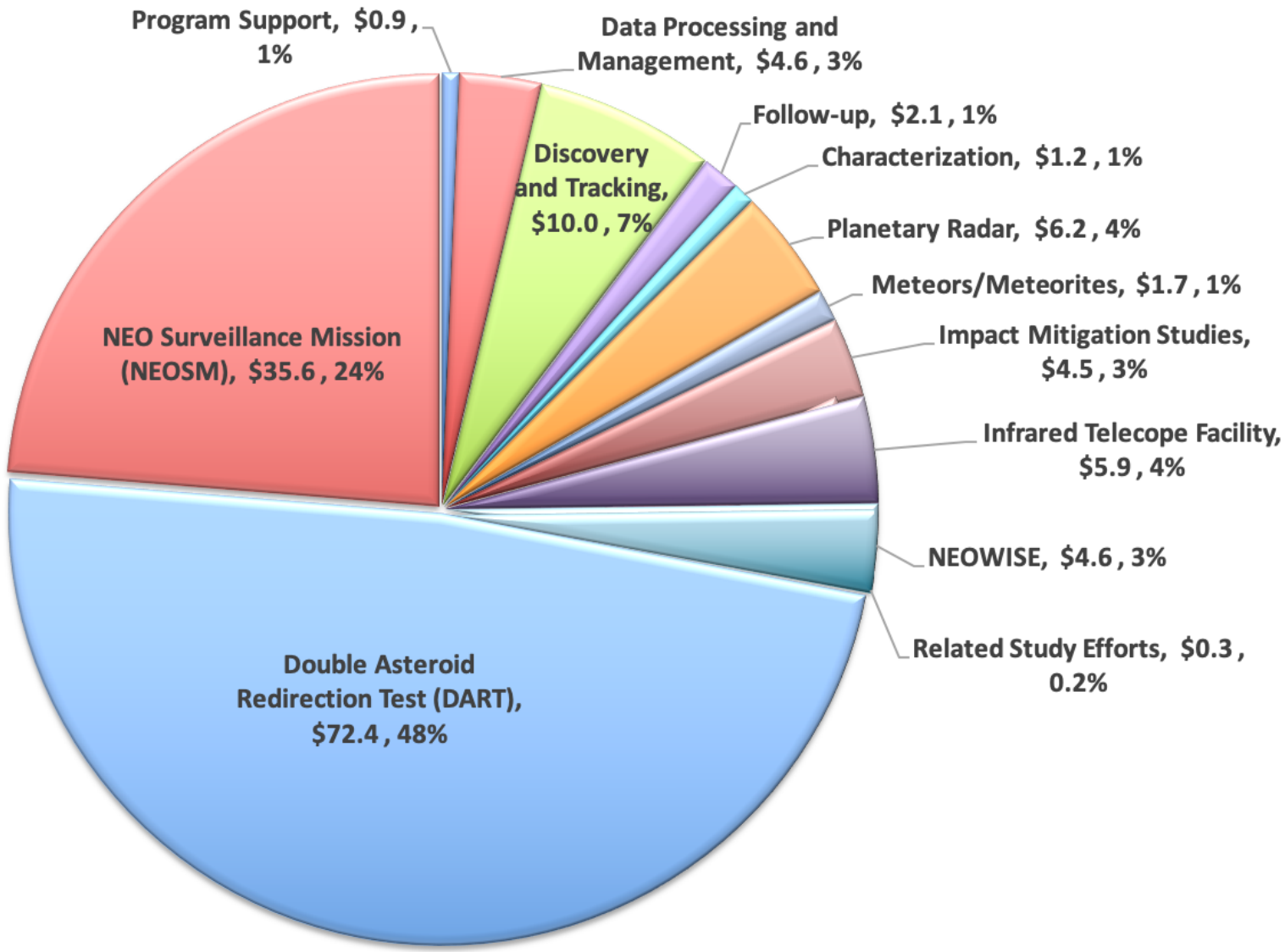
Planetary Defense Program FY2020 ($M) - $150M Total



Suggestions Briefed to Planetary Decadal Small Bodies Panel

Considerations for future Planetary Defense Flight Projects:

1. Although science can also benefit from Planetary Defense flight missions, the flight missions in this line are focused on NEO search and/or characterization, or in-space mitigation technology development. Currently, these are strategic, directed investigations as opposed to competed. As such, the report could identify specific prioritized planetary defense goals for “strategic missions”, even if the anticipated costs are below the current $500M competed mission threshold.
2. The panel should look for opportunities with Planetary Science flight missions where Planetary Defense objectives could be achieved with augmentation by Planetary Defense funding to add capability or enhance operations of otherwise purely Planetary Science missions.
3. Planetary Defense flight investigations believed executable for less than approximately $500 million should be identified and prioritized. They could be either directed to a specific purpose or, if for a more broadly identified objective (e.g. Apophis encounter), proposed by community investigators through an AO process to address the Planetary Defense goals and challenges identified.
4. It is not foreseen the projected budget for Planetary Defense would allow flight projects in excess of $500M development costs. However, if the panel finds specific flight investigations are needed with Life Cycle Costs (LCC) in the approximate range $500 million to $1 billion, the report should provide the candidate objectives to be achieved for each mission and they should be prioritized.

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nasa.gov/planetarydefense